M.O. 371.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 69
April
1934
No. 819

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

To be purchased directly from H.M. STATIONERY OFFICE at the following addresses: ADASTRAL HOUSE, KINGSWAY, LONDON, W.C.2; 120, GEORGE STREET, EDINBURGH 2; YORK STREET, MANCHESTER 1; 1, ST. ANDREW'S CRESCENT, CARDIFF; 80, CHICHESTER STREET, BELFAST; or through any Bookseller.

Travel of Thunderstorms

The correspondence that has been received on this subject, following Dr. Sutcliffe's letter in the February issue of this magazine, indicates that popular and widespread notions exist that the tracks of storms are related to topographic features. These generally take the form either that the storms regularly follow a river or range of hills, or that they rarely cross a river or pass over a particular locality. It is almost impossible for single observers to determine the motion of a storm accurately; co-ordination of observations from many observers is essential, but this does not yet appear to have been done in this country in sufficient detail to determine the soundness of these popular beliefs, although it is to be hoped that the collection of observations by Mr. S. Morris Bower will soon enable the question to be settled. Nevertheless two or three conclusions, which have been brought out in the correspondence, emerge from general considerations. These are best stated in relation to the two main types of thunderstorms, which are (*a*) those which occur in association with a cold front or cold occlusion, and which usually move moderately fast; and (*b*) those due to local instability which form in a region of little or no pressure gradient and have no very definite movement. Concerning the (*a*) type of storms, the conclusions are (i) that they would not be much affected by minor topographical features; (ii) that the general air motion may cause the storms to move on the whole in a certain direction, and

(5925) 32/91 1.000 4/34 M. & S., Ltd. Gp.303

this direction sometimes happens to coincide with that of a river valley or a range of hills. Such a case is described by Mr. Kruisinga in a letter received too late for inclusion in the magazine for March; the general directions of storms, river and range of hills near Heerde, Holland, are all from south-west to north-east. (iii) At any place the number of storms which appear to be approaching is necessarily much greater than the number which pass overhead, whatever the neighbouring topography may be. The storms of type (*b*) are more difficult to deal with as their motion is so often irregular, but it appears (iv) that when they are diffuse it is not easy to determine the centre or its motion, and (v) that with these storms even minor surface features as affecting temperature and humidity probably help to determine which way a storm is going to move or spread, or where one is going to develop. Mr. Kruisinga invokes a down draught of air over a river to explain why such a storm should not cross it, but this introduces another popular belief which would require a separate investigation. However, the relatively low temperature of a large enough water surface might have some such effect.

The collection and investigation of observations on thunderstorms has been undertaken in great detail in Germany over a number of years by the Prussian Meteorological Office.* The publications contain numerous diagrams of individual storms, which show that they generally extend over a "front" of about 50 to 150 or more miles in length, and that the front advances across country irrespective of the topography, often with little or no deformation. Several such fronts may be propagated over the same parts of the country within a few hours. A particular investigation† on the localities where the fronts originate or disappear further discredited any suggestion of topographic influence. Attention may also be drawn to "The Rainfall of the British Isles,"‡ part of Ch. X of which is devoted to the distribution of thunderstorm rain; fig. 79 (reproduced from *British Rainfall*, 1918, p. 50), is a good example of storm tracks lying across England in narrow belts from south-west to north-east, regardless of hills or valleys.

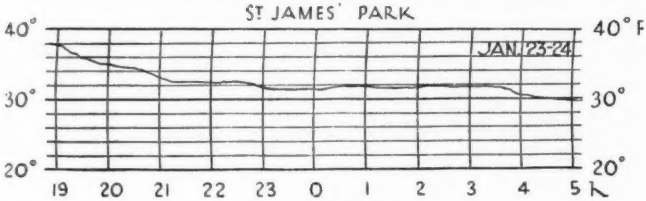
In conclusion, it appears that while it is everywhere only too easy for misconceptions to arise, the beliefs at some places do bear some relation to the facts; but that usually this relationship is itself in the nature of a coincidence and throws no light on the connexion between natural features and thunderstorms. Topography on a sufficiently large scale may exert some influence on the motion or intensity of thunderstorms, but it is clear that hills of only a few hundred feet in height and rivers a few hundred feet in width can have very little effect on the majority of storms.

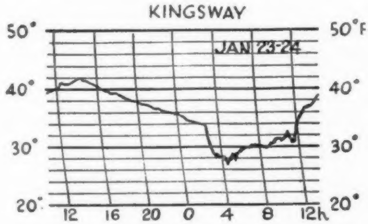
* K. Preuss. Meteor. Inst., Ergeb. Gewitterbeob., 1896-1921.
† loc. cit. 1908-9, p.8. ‡ by M. de C. S. Salter, London, Univ. Press, 1921.

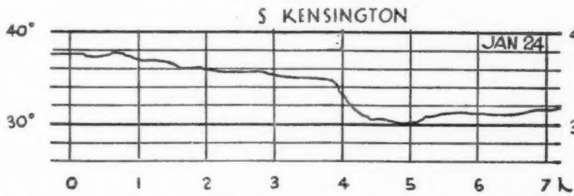
A sudden fall of Temperature at Kingsway. January 23rd-24th, 1934

During the night of January 23rd-24th, 1934, there occurred a very sharp fall of temperature in the thermograph record on the roof of the Air Ministry, Kingsway. Temperature fell a matter of 4°F. in about 10 minutes between 2h. 50m. and 3h. and a further 2° during the next 20 minutes. A fall of about 4° in half an hour occurred at South Kensington between 3h. 50m. and 4h 20m. but there was no such marked fall shown on the thermogram in St. James's Park.

The three thermograms are shown in the figure below and also

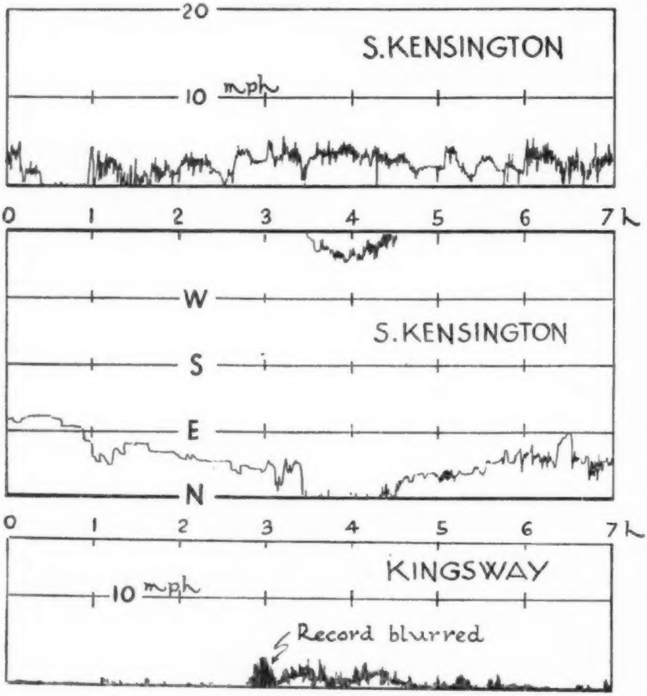






the anemograms from Kingsway and from South Kensington. The former of these anemograms shows that at the time when temperature began its abrupt fall puffs of air of two or three m.p.h. began to be felt (but it must be remembered that a Dines pressure tube anemometer does not record velocities with precise accuracy at such low speeds). These puffs went on till about 5h. 30m. and during that period there were small fluctuations of temperature after the main fall had occurred. At Kensing-

ton there was a light north-easterly drift up to 3h. 30m. but at that time the wind backed to north-north-west for the space of an hour, *i.e.*, while the temperature was falling abruptly. Inquiry was made of the forecaster on duty at Kingsway as to the conditions with regard to fog and he stated that, while he did not notice the exact time at which fog formed, he observed that at 2h. 30m. there was no fog while at 5h. 30m. it was thick enough to be visible streaming past the street lamps and at that



time the wind was from the north. At 7h. thick fog was recorded at Kew with visibility less than 220 yards but only mist at Croydon. A suggestion was made that the fall in temperature was due to the arrival of a slow moving mass of cold air but this suggestion would seem to be contradicted by the absence of the fall of temperature at the surface in St. James's Park. Another suggestion was that a sudden clearance of the sky occurred with rapid cooling by radiation. Again the St. James's Park thermogram seems to contradict this. The writer would,

however, put forward the theory that it is due to a similar cause as that suggested to explain certain sudden falls of temperature at Cardington.* The explanation there given is that the fog drops at the upper surface of a fog are cooled by radiation and that as they are stirred up they cool higher and higher layers of the atmosphere, so that the sudden fall in temperature is due to the upward propagation of the fog surface. In the Cardington records it was seen that the fall was not abrupt at the surface but became more so with increase of height. The same phenomenon is also present in this case where there is no abrupt change at the surface in St. James's Park but the fall was abrupt at South Kensington 60 feet above the street level and even more so at Kingsway 90 feet above street level.

If this view is correct some explanation is necessary of (*a*) the change in wind direction at Kensington as the fall occurred, and (*b*) the upspringing of puffs of air at Kingsway. When cooling is occurring over the Kensington area there will be a tendency for the air to be canalised from Kensington Gardens along Exhibition Road, especially when the inversion is sharp; this would give a flow from north-north-west down the hill. As I picture it the inversion was confined to the surface of the fog, and hence when the inversion had risen well above the tops of the buildings, there was no longer the same tendency to canalisation and the wind once more returned to north-east. The puffs of wind at Kingsway may be due to a similar cause, but alternatively in conjunction with the thermal fluctuations between 3h. and 5h. 30m. it is possible that their explanation may be the formation of a cellular structure in the fog as I suggested in the article to which I have already referred.

C. S. Durst.

The prediction of minimum screen Temperatures at Larkhill on winter nights

By R. T. Andrews.

A demand for the issue of frost warnings from the Meteorological Office at Larkhill has led to the consideration of statistical methods for predicting night minimum temperatures. In the *Monthly Weather Review Supplement No.* 16 are given empirical formulæ which are used for this purpose at various stations in the United States. In this country formulæ have been given by W. H. Pick and others† which are applicable to Cranwell and Calshot. The formulæ used in the United States are discussed by Ellison‡ who is careful to point out that these formulæ are

*A Note on Radiation Fog. *Meteorological Magazine*, June, 1933, p. 108.

† W. H. Pick and J. Paton, *Meteorological Magazine*, February, 1928, p. 20, and W. H. Pick and D. F. Bowering, *Meteorological Magazine*. June, 1929, p. 114.

‡ E. S. Ellison, *Monthly Weather Review*, December, 1928.

only likely to be valid on level ground, the subsidence of cooled air on hill tops into the valleys complicating the phenomena in hilly country.

The station at Larkhill is situated on a ridge 440 feet high which runs from north-west to south-east. The ground falls away gradually to about 200 feet on the east side and 300 feet on the west. Owing to the undulatory character of the ground it was decided at the outset to abandon any attempt to construct a prediction formula, which *a priori* would be unlikely to hold good except on level ground. In place of the formulæ the construction of a table was proposed which would show for given temperature and humidity conditions at 15h., the probable fall of temperature during the night, provided that the sky would clear and that the wind strength during the night would be between certain limits. The 15h. observations were selected

TABLE I.

Mean difference between 15h. temperature and minimum screen temperature. Clear or partly clear nights—Larkhill, October to March, 1920-1933.

Temperature 15h.	25°—34°F.		35°—44°F.		45°—54°F.		55°—64°F.		>65°F.	
Wind Vel.(m.p.h.)	0—10	10—20	0—10	10—20	0—10	10—20	0—10	10—20	0—10	10—20
Rel. Hum. 15h.										
90—100%	12	...	10	9	11	12	...	...	...	...
80— 89%	11	10	13	10	14	9	12	...	...	...
70— 79%	14	7	15	11	16	13	19	13	...	...
60— 69%	12	10	14	13	17	16	19	15	21	...
50— 59%	14	11	16	12	18	17	20	...	20	...
40— 49%	...	...	16	18	19	20	29	21	24	...
30— 39%	...	...	...	...	20	15	26	27	28	...
20— 29%	...	...	...	...	...	...	26	...	...	...

because, in order to be of any practical utility the frost warnings had to be issued soon after 15h. The limits selected for wind strength were (i) 0-10 m.p.h. (ii) 10-20 m.p.h. In the use of such a table the temperature and humidity at 15h. would be known quantities, the unknown quantities which would have to be predicted being the state of sky during the night and the mean strength of the surface wind.

In order to construct this table observations were extracted on all occasions during the winter months October to March, 1920-33 when the sky cleared at any time between 15h. and 9h. No special significance was given to an occasion when frost actually occurred. In the first place a table was made of the temperature at 15h., the relative humidity at 15h., the night minimum temperature and the mean strength of the surface wind during the night. The next stage was to find the differences

between the 15h. and night minimum temperature representing the fall in temperature during the night below the 15h. reading, and to group these differences for specified ranges of temperature and humidity. Two sets of groups were formed according to whether the mean strength of the wind during the night was below or above 10 m.p.h. Finally the mean of the values entered in each group was derived and the resulting table was of the form which it was sought to construct. This table is reproduced as Table I.

It is interesting to note that when the temperature at 15h. is between 35° and 44°F. the frequency of frosts with light winds is only very slightly greater, about 10 per cent., than with moderate winds.

The fall in temperature overnight must depend very largely on

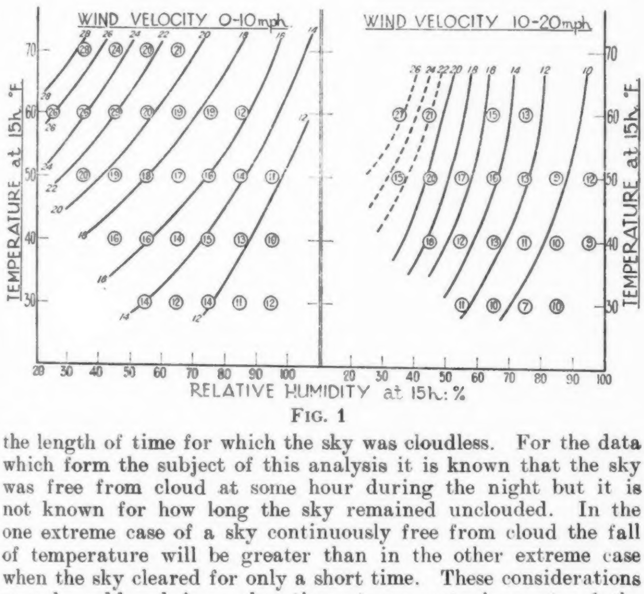


FIG. 1

the length of time for which the sky was cloudless. For the data which form the subject of this analysis it is known that the sky was free from cloud at some hour during the night but it is not known for how long the sky remained unclouded. In the one extreme case of a sky continuously free from cloud the fall of temperature will be greater than in the other extreme case when the sky cleared for only a short time. These considerations may be adduced in explanation at any rate in part, of the divergence of individual observations from the mean. A further contributory cause of scatter may be the subsidence of cooled air emphasised by Ellison. Subsidence may be expected to offset the effects of radiative cooling and the fall in temperature would therefore be diminished.

A more detailed investigation of those occasions when the fall

in temperature is much greater than the mean has shown that it is associated with one or more of the following conditions.

(1) A neutral area between two anticyclones or between two shallow depressions.
(2) Clear sky both day and night.
(3) Clear sky at night with snow lying.
(4) Passage of cold front after 15h.

In Fig. 1 isopleths of the differences between the 15h. and night minimum temperature have been drawn in order to show the varying magnitude of the fall with temperature and humidity, for both light winds (0-10 m.p.h.) and moderate winds (10-20 m.p.h.). From the isopleth diagram for light winds it may be seen that the temperature and humidity are of nearly equal importance. For moderate winds the isopleths approximate more closely to the vertical thus showing that with appreciable turbulence humidity is of greater importance than temperature. In both sets of curves there is congestion for high values of temperature and low values of relative humidity.

In conclusion it may be added that the fall in temperature which has been utilised in the foregoing analysis is not greatly different from the diurnal range of temperature. Thus any conclusions which may be drawn from the data as to the variations of the difference between the 15h. and night minimum temperature may be applied without serious error to the diurnal range of temperature.

Correspondence

To the Editor, *The Meteorological Magazine*.

Summer Thunderstorms and Summer Time

The annual census of summer thunder in the British Isles is being continued between April 1st to September 30th of the present year. I shall again very much appreciate the valuable help of your readers in the work of observation. The main details required are the place, date and time of the occurrence of thunder, lightning or hail, with direction in which the lightning is seen, especially at night. In the case of actual thunderstorms additional information of the following character will be welcome :—

1. Time of first observation of thunder or lightning, with direction and estimated distance.

2. Time of commencement of very heavy rain or hail, or approximate time of nearest approach of storm, with direction and estimated distance.

3. Approximate time of final observation of thunder or lightning, with direction.

4. Severity of storm; changes in direction or strength of wind, change in temperature, &c., during the storm.

It is essential that the position from which the observation is

made should be specified by mentioning the approximate distance and direction from a railway station or by the use of an observing station number.

After the clocks have been " advanced " on April 22nd, great care must be taken in regard to reporting times. The 24-hour clock to be introduced experimentally by the B.B.C. on April 22nd is based on British summer time, whereas the 24-hour clock in current meteorological use reads Greenwich mean time. Both systems have their zero-hours in the night. The practice has unfortunately grown up of assuming in many cases that a 24-hour clock reads G.M.T., and that a 12-hour clock employs B.S.T. It therefore becomes especially important that the identification letters B.S.T. or G.M.T., as the case may be, should be added on every record, and that a.m., or p.m., should also be included whenever a 12-hour clock has been used.

S. Morris Bower.

Langley Terrace, Oakes, Huddersfield. March 29th, 1934.

A "Fireball"

I think I have read somewhere recently, or heard on the wireless, that anyone observing a " fireball " is invited to report it to the Meteorological Office.

We have just been having a sharp thunderstorm with much hail, lasting about ½ hour. At 10.7 p.m., I was watching the lightning from a north window and saw, immediately after a flash had blacked out, a ball (looking about the size one sees the moon) passing from west to east in a low arc—travelling relatively slowly (visible 1 second)—for a distance which I judge to have been perhaps 200 or 300 yards. The thing may have been ¼ mile away from me, or less, and below, because we stand on the ridge of a steep hill. It was not very luminous—not enough to light up anything, to fix its position; and very heavy hail was entirely blotting out the lights of the houses lower down the hill, so my estimate of ¼ mile away may be quite wrong. Its colour was yellow, whereas the lightning proper was conspicuously violet, and very intense.

E. M. Wishart.

92, *Stewarton Drive, Cambuslang, Glasgow. March 5th,* 134.

A Rainbow in Cirro-Stratus

On the morning of March 24th last an optical phenomenon unique in the writer's experience was visible from this part of Hertfordshire. At 9h. the sky was flecked near the zenith with thin cirrus filaments moving rapidly southward, while to west and north-west a bank of cirro-stratus, or cirro-nebula,

forming the advance-guard of a warm front which brought slight but steady rain 2½ hours later, had reached an elevation of about 15°. No medium or low cloud was within sight, though the valley in which the Rickmansworth climatological station is situated contained some dispersing ground-fog. Just after 9h. a faint, whitish arc, about 1½° wide, was noticed in the north-west, with its apex close to the top of the cirro-stratus pall. During the next few minutes this arc brightened considerably, and at the same time developed a reddish-brown tinge at both outer and inner margins. Measurements made with a prismatic clinometer-compass at 9h. 10m. left no room for doubt that the phenomenon was actually some species of rainbow. The angles subtended by arc and sun agreed, as nearly as could be determined, with those demanded by theory. That the bow was not a product of the ground-fog rather than of the cirro-stratus was ascertained from another series of observations made at 9h. 20m. on a neighbouring hill-side, where the atmosphere was quite clear. Towards 9h. 30m. the spectacle suddenly faded.

In the "Meteorological Glossary," 2nd edition, s.v. Clouds, it is written: "there are certain very delicate forms of cirrus and cirro-stratus (with no long threads) which may cause brilliant coronæ and iridescence, and probably consist of very small spherical globules, and not of ice crystals." It seems necessary to infer that the cirriform clouds which gave rise to the phenomenon just described were of some such type. The absence of the normal spectrum colours can be explained on the assumption that the super-cooled water droplets which generated the arc were, as in the case of a fog-bow, of the order of only 0.05 mm. in diameter. Even if the cirro-stratus mass under discussion was at no greater altitude than 25,000 ft., the bow seen on it must have been at a distance of fully 20 miles from the point of observation.

E. L. HAWKE.

Caenwood, Rickmansworth, Herts. March 27th, 1934.

Austausch

In preparing a paper recently, I have had occasion to look for a complete English equivalent of the German word *Austausch*. This word, in its full form *Massenaustausch* was, I believe, introduced into continental meteorological literature by Dr. Wilhelm Schmidt, and it has certainly proved a boon in a language in which, generally speaking, brevity and learning do not often go hand in hand. When the German meteorologist talks of "Austausch in der bodennahen Luftschicht," for example, he means a consideration of the processes which give rise to our three terms "eddy conductivity, eddy viscosity, and eddy diffusivity." To replace *Austausch* by its literal equivalent

" exchange " seems to me hardly to be recommended in view of the limited meaning which the noun " exchange " has in ordinary usage. The only other word that suggests itself at the moment is " interchange," but this is hardly a happy alternative. Finally there is a suggestion that meteorologists should take the word *Austausch* into the English language much in the same way as the mathematical physicist has recently adopted *Eigenwerte*. We should then have a single word specifying that aspect of turbulent motion which gives rise to the transfer of heat, momentum or mass from one layer of the atmosphere to another.

It seems to me that the need is a real one. In continental literature, I believe I am right in saying that *Austausch* is a sufficiently general term to indicate that the writer is not thinking of the transfer of any specific entity or of any particular theory or model of the eddy structure of the atmosphere. There is no such single word in English, unless it be Dr. Richardson's " turbilivity," but this does not appear to have passed into general use, and in any case, refers to the coefficient of eddy conductivity, viscosity or diffusivity and not to the whole process itself.

It would be of interest to have the opinion of those who are better qualified than myself to discuss this matter of the formation of the technical terms of a young science.

O. G. SUTTON.

W.D. Experimental Station, Porton, Wilts. *March 25th*, 1934.

A Disregarded Condition for Dew and Hoar-frost

It is remarkable that in nearly all text-books it is virtually implied that the deposited moisture which we call dew and hoar-frost (as distinct from fog-drip and rime) results only through nocturnal cooling by radiation in clear, calm weather. But the formation of dew and hoar-frost in cloudy weather when a damp wind comes in contact with cold ground is not at all uncommon even in lowland country, and among mountains is of great meteorological importance. We are familiar with the " sweating " of London pavements in cloudy winter weather when no rain or drizzle has fallen, and I remember a case of hoar-frost being similarly formed one evening during the cold December of 1925 when a damp SW. wind sprang up.

In one of the late Canon Rawnsley's vivid Lake Country sketches he describes how when the death-like stillness of intense cold was reigning on the high fells the springing up of a damp wind off the Irish Sea caused the mountain sides to become virtually snow-clad though no flakes were in the air and there was no mist to deposit rime. Similarly huge spears of hoar-frost forming on projecting rocks have been observed at

mountain observatories like Ben Nevis and Mount Fanaraken in Norway. As regards the latter mountain, H. W. Ahlmann refers to huge " snow-drifts " in the vicinity of the observatory that have consisted almost entirely of hoar-frost which he considers plays a much more important part than actual snowfall in the nourishing of the glaciers of the Horunz Massif in Jotunheim. In this estimate, however, he says nothing about rime which is technically distinguished from hoar-frost as frozen fog-drip. At any rate there can be no doubt that deposited moisture is an important feature in mountainous regions, and one wonders to what extent it swells the big precipitation figures in the rainy upland districts of Great Britain.

L. C. W. BONACINA.

35, *Parliament Hill, London, N.W.*3. *March* 3*rd*, 1934.

NOTES AND QUERIES

Sheathed Thermometers

For some time past the Meteorological Office has adopted thermometers in which the stem is protected by a glass sheath instead of by a porcelain or wooden mount for use in Stevenson screens. A set of these thermometers, comprising dry and wet bulbs, maximum and minimum, mounted in a screen, is shown in the accompanying illustration.

Long experience with the thermometers of the older pattern had brought to light certain defects in their design. In order that the scales of the dry and wet bulb thermometers should be visible over the range of temperature likely to be experienced, the maximum and minimum thermometers which are placed in front of them in the screen had, owing to their large mounts, to be spaced far apart, the one near the top and the other near the bottom of the screen. Such an arrangement left much to be desired. There exists some evidence of a temperature gradient within the screen which renders it desirable that the bulbs of the four thermometers should be placed as close together as possible.

It was during the discussion of these and kindred problems that, in 1927, the idea occurred to Colonel E. Gold, F.R.S., of making the maximum, minimum and dry and wet bulb thermometers similar in pattern to the grass minimum thermometer by protecting their stems with a glass sheath and so doing away with their several mounts. This change was beneficial also in another way in that the trouble which so frequently arises from the black coming out of the stem markings owing to " weathering " on the old thermometers was overcome. It was this defect that, about 90 years ago, led G. Leach to surround stems of his thermometers with a glass tube sealed with cork

and 30 years later caused G. Symons to suggest the use of a glass sheath fused to the stem.

Extensive trials of the new sheathed thermometers were made from 1928 to 1930 during which time a suitable support for mounting them in the screen was devised. The results of the tests proved satisfactory and warranted making this type of thermometer standard for official use at land stations, where they have been adopted since 1931. A further advantage accrued in that the grass minimum thermometer no longer needed to differ from the screen minimum, one pattern of instrument serving for both purposes.

In addition to preserving the black in the stem graduations and to ensuring that in the screen none of the graduations of the dry and wet bulb thermometers are hidden, both of which factors contribute to the accuracy of temperature observations, other advantages arising from the use of these sheathed thermometers may be mentioned. No longer does there exist the danger when reading a thermometer of a large error due to the stem working loose in the mount and becoming displaced. Glass, unlike wood and porcelain, does not deteriorate with age and it is easy to clean. As a result the appearance of the thermometers and the legibility of their scales are preserved. The small width of the sheath also allows the bulbs of the maximum, minimum and dry bulb thermometers to be situated near to each other as will be apparent in the illustration which forms the frontispiece of this number of the magazine.

Sheathed thermometers have, in spite of their apparent fragility, proved to be eminently satisfactory and have fully justified the decision of the Meteorological Office to adopt them as the standard pattern for use in the Stevenson screen.

The late Mr. W. Pilkington, M.P.S.

We regret to record the death on March 12th, 1934, of Mr. W. Pilkington, Borough Meteorologist of Buxton from 1899 to 1923. Mr. Pilkington was born in Buxton in February, 1868, and spent most of his life in his native town. He qualified as a chemist and druggist in 1889 and immediately afterwards opened the business in the Market Place which is still carried on by his son. He was always specially interested in meteorology, and after his retirement in December, 1923, when his daughter, Miss E. W. Pilkington, M.P.S., succeeded him as Borough Meteorologist, he continued to act as deputy observer.

Besides being a keen and able meteorologist Mr. Pilkington had a strong sense of humour, and he tried to brighten "dull" days by displaying in the window of his chemist's shop a local daily weather forecast couched in humorous language, which gained for him a fame extending far beyond the limits of his

own town. His daughter, Miss E. W. Pilkington, has carried on this tradition "of enlivening the dullest day." By a curious coincidence our attention was drawn to these forecasts quite recently by Mr. H. Everard, and a typical example was printed in the February, 1934, number of this magazine. The following report refers to Saturday, April 29th, 1933, the day of the Cup Final at Wembley:—

BUXTON WEATHER PROSPECTS.

(Local Meteorological Forecast.)

Date: Saturday, April 29th 1933. Sun Rises, 5.37 a.m.
Sun Sets, 8.19 p.m.
Buxton Time 7.6 minutes later.

Temperature.—A fairly big party of therms has left this district, en route to Wembley.

Pressure.—Playing steadily, without rushing up or down the field.

Rainfall.—Is likely to score several goals during the day.

Winds.—Supporters are arriving from all quarters.

Current Notes.—A depression from the Hebrides and an anti-cyclone from Greenland are the opposing teams.

Further Outlook.—Neither side gains a complete victory even after extra time.

Propitious Features.—The steady playing of the pressure.

Ominous Symptoms.—Captained by the winds.

TO-DAY'S LOCAL WEATHER HANDICAP.

Maximum Points For or Against.		+	–
10	Pressure: Unmoved	4	0
3	Humidity: Rising	0	1
8	Winds: Variable; moderate	1	3
5	Local Trend: Full of interest	2	1
5	Distant Influences: The struggle is not yet over	2	1
		+9	–6
	Points in favour ...	3	

Inference—All the players, sun, rain and wind, give a good account of themselves during the week-end; clouds referee throughout the match; the destination of the Cup will be in doubt until the last.

Shortly before his death Mr. Pilkington perfected and patented an ingenious weather forecaster, a specimen of which has been forwarded to us by Miss Pilkington. By means of a

number of concentric rotatable discs "handicap values," for or against fine weather, due to barometric pressure, wind direction and barometric change, are read off. From the resultant figure the forecast is ascertained by reference to a table. The "forecaster" is obviously the result of a thorough analysis of statistics and seems likely to yield a high percentage of successes. It is being placed in the museum in the Meteorological Office Library.

Tornado at Carbis Bay, Cornwall

The following account of a small tornado is abridged from one given in the *Cornish Post and Mining News*, which was forwarded to the Meteorological Office by Mr. E. W. Newton. The tornado appeared at Carbis Bay, near St. Ives, a few minutes before 8h. on Saturday, January 13th, 1934. Its track lay down a valley, but at one point it turned and retraced its path for about 100 yards and then resumed its original direction. In its passage it carried with it what is described as a swirling mass of tree branches, stones and corrugated iron, which were tossed about in the air with amazing force. The branches of trees were caught up and screwed around the trunk, and huts were wrenched off their foundations. At one house the tiles were stripped off the roof, one of them being found about a hundred yards away; the chimney was carried away and panes of glass were smashed. A spectator having first noticed a "loud rushing sound, as if it were hailing," then saw "a large black mass like a dark cloud, twice the size of a house, and in the shape of an inverted cone. As it approached, branches of trees and large stones were seen swirling around in the midst of it. They were spinning around at the top, and then would fall towards the ground, only to be caught up again and sent whirling to the top." It was preceded by heavy rain, but it is not stated whether rain fell within the limits of the tornado.

Similar miniature tornadoes have occurred previously in the British Isles, and descriptions of two of these, the south Wales tornado of October 27th, 1913, and the London tornado of October 22nd, 1928, have been published in this magazine (February, 1914, and November, 1928, respectively). On the occasion of the present one the pressure situation at 7h. was characterised by a deep depression centred between Iceland and Scotland (Thorshavn 965 mb.) with a gradient for moderate to strong west-south-westerly winds over the British Isles. A small secondary was indicated to the south-south-west of Ireland and this subsequently developed and moved east-north--east. The place of occurrence of this and previous English tornadoes resembles that of the violent tornadoes of the United States, which develop in the south-east quadrant of large depressions.

Reviews

Pilot Balloon Observations at Mauritius. By R. A. Watson, B.A., and N. R. McCurdy, B.Sc. *The Cyclone Season* 1929-1930 *at Mauritius.* By R. A. Watson, B.A., and N. R. McCurdy, B.Sc., and *The Cyclone Season* 1930-31 *at Mauritius.* By M. Herschenroder, B.Sc., Royal Alfred Observatory, Mauritius, Publications Nos. 11, 12 and 13.

Publications Nos. 12 and 13 deal with the "cyclone seasons" of 1929-30 and 1930-1 at Mauritius, and are on similar lines to Publications Nos. 7 and 10 (1927-8 and 1928-9) which have previously been reviewed in this magazine.

During the season 1929-30, which is stated to have been anomalous in the complexity of its daily weather maps, numerous "lows" were observed of considerable depth but not vigorous enough to be classed as tropical cyclones, and some difficulty was experienced in deciding which of the disturbances should be included in the statistics of cyclones. The cyclone of September 23rd-27th, 1929, formed nearer the equator than usual and filled up in lat. 10° S.; it is only the second September cyclone in 119 years.

The season of 1930-1 was on the whole less disturbed, six cyclones being recorded, but the cyclone of March 3rd-9th, 1931, so far as the Observatory records go, was second in intensity only to the historic storm of April, 1892. The data and charts given in these memoirs will be found useful by those who are interested in the problem of the cyclonic storm.

In Publication No. 11, Part I, is given the results of observations in the period July, 1928, to December, 1929, and also these results combined with earlier work into frequency tables of velocity and direction of wind at various altitudes.

The structure disclosed of the atmosphere between the ground and 8,000 metres is briefly :—

(*a*) A surface layer of light to moderate easterly winds.

(*b*) A layer of light and rather indefinite winds.

(*c*) A layer of moderate to strong westerly winds.

At all levels the winds are stronger in mid-winter. In the lowest layer there is a considerable southerly component in mid-winter and a small northerly component in mid-summer, layer (*b*) extends in mid-winter between 2,000 and 3,000 metres, but in mid-summer between 2,500 and 6,000 metres. These statements refer to average conditions and individual cases may differ considerably.

In Part II a discussion of the results is given. By differentiating the ordinary hypsometric equation and introducing various assumptions the authors derive a formula for the height at which occurs the separation between lower easterly and upper westerly winds, between about 5° and 20° of latitude. (The authors consider that in practice the ordinary geostrophic wind

formula may be used to 5° latitude) and the agreement between theory and observation appears fairly good. The number of places remote from large masses of land, at which upper wind observations have been made is, however, small. A study has also been made of the temperature gradients at various levels as calculated from individual ascents. This is regarded as a promising line of investigation.

This work is a praiseworthy attempt to give something beyond the usual bare tables of figures associated with so many year-books and similar publications.

S. T. A. MIRRLEES.

Solar Radiation. By C. G. Abbott, Washington, D.C., Smiths. Rep., 1932, pp. 107-20; and *Sunspots and Weather*, by C. G. Abbot, Washington, D.C., Smiths. Misc. Coll., Vol. 87, No. 18, 1933, pp. 1-10.

In these two short papers Dr. Abbot continues his account of his investigation of solar radiation and its relation to terrestrial weather. The first gives a general description of the solar radiation, its constitution and periodicities, and its effects on terrestrial weather and plant growth.

The second paper deals in greater detail with solar and terrestrial periodicities. The author finds that changes of phase and amplitude in short weather cycles are related to the number of sunspots, the phase of the 11-month temperature cycle at Bismarck, North Dakota, being five months later when spots are few than when they are numerous. Cycles of solar radiation, and many weather cycles, are sub-multiples of the double sunspot cycle to which a length of exactly 23 years is assigned. This cycle is also found in the annual layers of glacial clay deposited at the end of the Quaternary Ice Age. Finally a brief reference is given to weather forecasting by the aid of solar variations.

Books Received

Thunderstorms in the Peninsula during the premonsoon months April and May. By S. P. Venkiteswaran, B.A., India Meteor. Dept., Sci. Notes, Vol. iv, No. 44. Calcutta, 1932.

Obituary

Dr. J. P. Van der Stok.—We regret to learn of the death of Dr. Van der Stok, which occurred on March 29th last. Dr. Van der Stok was born at Zuylen near Utrecht, on January 14th, 1851, and was educated at the University of Utrecht, receiving the degree of doctor in 1874. Shortly afterwards he was appointed Vice-Director of the Batavia Observatory and was sent to Kew Observatory to study the photographically recording

instruments there before he proceeded to Batavia in 1877, taking with him a number of these instruments. On the retirement of Dr. P. A. Bergsma in 1882, Dr. Van der Stok was appointed Director. In 1899 he returned to Holland and until his retirement in 1923 he was Director of the Section of Oceanography and Marine Meteorology in the Netherlands Royal Meteorological Institute. He was the author of numerous papers, especially on the subjects of climatology and marine meteorology.

The Rev. Walter Edward Stewart, M.A.—We regret to learn of the death of the Rev. W. E. Stewart, on January 24th, 1934, in his 76th year. Mr. Stewart had forwarded for inclusion in *British Rainfall* rainfall records covering 43 years, from Oundle, Northants, 1866, Hurworth, near Darlington, 1890 to 1903, Longney to the south-west of Gloucester, 1905 to 1911, and Scalby, near Scarborough, 1912 to 1933. In three cases the records were sufficiently long to enable estimates of the average annual rainfall in those localities to be made. From 1887 to 1904 Mr. Stewart was Vicar of Eryholme, and by his efforts the fine little Norman Church was restored. From 1904 to 1912 he was Vicar of Longney, where, as at Eryholme, he won the hearts of the people by his kindliness and consideration. Owing to ill-health, Mr. Stewart retired in 1912 to St. Phillips, Scalby, near Scarborough, where he continued the rainfall record.

News in Brief

The Council of the Royal Society of Edinburgh has awarded the Keith prize for the period 1931-3 to Dr. A. Crichton Mitchell for his paper on "The diurnal incidence of disturbance in the terrestrial magnetic field."

We learn from *Nature* that a conference is to be held in Leningrad in April at which the study of the stratosphere is to be discussed.

Corrigendum

With the issue of the Piccard balloon stamps described in the March number of this magazine p. 30, there should have been mentioned also one for 2f. 50c. in violet.

The Weather of March, 1934

Pressure was above normal over most of North America and across the North Atlantic to Portugal and north-west Africa and also over northern Scandinavia and Russia, the greatest excesses being 5·2 mb. at 50° N., 120° W., 10·8 mb. at 40° N., 40° W., and 11·9 mb. at Waigatsch. Pressure was below normal over Baffin Land, Greenland, Spitsbergen, Iceland and the rest of Europe, the greatest deficit being 8.1 mb. at Jan Mayen.

Temperature was above normal in Spitsbergen, Scandinavia and central Europe, being as much as 23·9° F. above normal at Spitsbergen, but below normal in south-west Europe. Rainfall was considerably above normal in Svealand, but about normal elsewhere in Sweden.

The weather of the British Isles during March was generally unsettled with gales during the middle of the month and an excess of rainfall in most districts but a deficiency in parts of Scotland and north-west England. Pressure was considerably below normal while sunshine was much above normal in north Scotland but below normal in the south of England. From the 1st to 9th the British Isles were under the influence of troughs secondaries associated with low pressure systems passing to the north of these islands and from then until the 22nd complex depressions passed directly across the country. As a result unsettled weather was experienced in all ditricts with many bright periods but also periods of continuous rain or drizzle and showers of snow, sleet or hail. Thunderstorms were experienced in Scotland on the 3rd, in Scotland and the Midlands on the 5th and 10th, in south and east England on the 15th and in north Ireland on the 17th, while gales prevailed in various parts from the 11th to 19th reaching Beaufort force "9" at Inchkeith on the 12th and 13th. The heaviest rainfall occurred on the 11th, 12th, 14th, 16th and 17th, 1·58 in. being measured at Blaenau-hydfer, Brecon, on the 17th, 1·53 in. at Borrowdale, Cumberland, on the 16th, and 1·43 in. at Eggleston, Durham, on the 11th. There were, however, many intervals of fair to fine conditions, particularly so on the 3rd, 7th, 9th (in south only), 18th, 19th (in Scotland) and 21st (except in the south), 9·9 hrs. bright sunshine occurred at Ross-on-Wye and Plymouth on the 3rd, 10·1 hrs. at Oxford on the 7th, at Inverness and Nairn on the 19th and at Inchkeith and Leuchars on the 21st. Frosts occurred locally at times, among the lowest readings recorded being 12° F. in the screen and 5° F. on the ground at Rhayader on the 1st, and 14° F. in the screen and 7° F. on the ground at Dalwhinnie on the 14th. Mist or fog occurred locally in England from the 1st to 14th and again on the 21st and 22nd. From the 23rd to 26th pressure was high to the south but troughs of low pressure passed across the country so that the fair weather was interrupted by periods of rain or drizzle. Day temperatures rose above normal during this period, 61° F. being recorded at Dundee on the 24th and at Collumpton on the 25th, while several places in Scotland and the Midlands also reached 60° F. on the 24th and 25th. On the 27th and 28th under the influence of an anticyclone which had spread in from the Atlantic fine conditions prevailed though day temperatures were lower and over 10 hrs. bright sunshine was enjoyed at many places, 11·5 hrs. at Aberystwyth and Morecambe on the 27th, and 11·6 hrs. at Armagh on the 28th. From the 29th

to the end of the month pressure was high to the north-east and low to the south and west with mainly cloudy to dull weather and day temperatures below normal. On the 31st brighter conditions prevailed though the temperature still remained low. The distribution of bright sunshine for the month was as follows :—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	146	+41	Liverpool	95	— 9
Aberdeen	142	+35	Ross-on-Wye	112	+ 4
Dublin	..	..	Falmouth	113	—22
Birr Castle	118	+ 8	Gorleston	130	+ 7
Valentia	117	+ 2	Kew	110	+ 7

The special message from Brazil states that the rainfall in the northern regions was abundant with 3·50 in. above normal but scarce in the central and southern regions with 2·16 in. and 1·73 in. below normal respectively. Five anticyclones passed across the country and several depressions, while high winds were experienced in the south. The crops were generally in good condition owing to favourable weather conditions. At Rio de Janeiro pressure was 1·2 mb. above normal and temperature 0·4° F. above normal.

Miscellaneous notes on weather abroad culled from various sources.

The snowfall in Switzerland during the 11th to 13th was said to be the heaviest of this winter; in the Engadine about 4 ft. fell, but in the western regions the average fall was about 2 ft. making ski-ing conditions again good generally. Bad weather prevailed in north and central Italy on the 12th and 13th; high seas caused extensive damage along the Italian Riviera and three people were killed at Savona, whilst the Arno overflowed its banks. A violent storm accompanied by hail swept the province of Brabant, Belgium, on the 17th and much damage was done; after the storm rain continued to fall until the 20th. (*The Times*, March 3rd-21st.)

A strong gale caused a fire which had started in Hakodate, Japan, at 7 p.m. on the 21st to spread throughout most of the city—700 people were killed. After the gale subsided, sleet began to fall and then heavy snow. (*The Times*, March 23rd.)

Severe bush fires occurred in South Australia during the early part of the month, but by the 11th they were under control. A heat wave passed across South Australia from about the 3rd to 11th, 110·5° F. is said to have been recorded in Adelaide on the 9th which is the highest temperature ever recorded there in March. Thick fog occurred at Sydney on the 9th and 16th. (*The Times*, March 10th-12th.)

A thaw set in in eastern Canada about the 4th, but on the 20th from Saskatchewan eastwards Canada was in the group of another cold spell. A tornado struck New Orleans soon after

8 a.m. on the 26th and many people were injured. Temperature was below normal generally in the eastern United States, but above normal along the Pacific coast and in the Mountain Region, while precipitation was mainly deficient along the Pacific coast but irregular in distribution elsewhere. (*The Times*, March 5th-27th, and *Washington, D.C., U.S. Dept. Agric., Weekly Weather and Crop Bulletin.*)

Severe gales were experienced frequently on the North Atlantic between the 8th and 22nd and much fog occurred off Nova Scotia. (*The Times*, March 6th-23rd.)

Daily Readings at Kew Observatory, March, 1934

Date	Pressure, M.S.L. 13h	Wind, Dir., Force 13h	Temp. Min.	Temp. Max.	Rel. Hum. 13h.	Rain	Sun	REMARKS (see p. 1)
	mb.		°F	°F	%	in.	hrs.	
1	1012·9	ENE.2	31	44	68	—	4·5	ps_0 early. f 14h.-20h.
2	1012·7	SW.3	28	47	70	0·09	1·1	r_0-r 15h.30m-21h.
3	1022·1	NW.3	34	48	46	—	7·8	x early
4	1025·5	W.3	32	48	67	—	4·1	ir_0 2h.-4h. ; 18h.
5	1009·1	SW.2	42	51	89	0·09	2·8	r-r_0 5h-12h.
6	1000·0	Calm	39	46	87	0·28	0·1	r-r_0 11h.-17h.
7	1007·9	WNW.3	33	48	49	—	8·8	x early
8	1013·5	WSW.3	31	49	52	—	3·9	x early
9	1007·6	E.3	30	50	45	—	4·9	x f to 11h.
10	998·3	SW.3	39	52	63	0·11	4·9	r early ; prh 14h.30m.
11	981·4	SSW.3	43	49	83	0·11	1·2	r-r_0 morning
12	977·5	Calm	39	46	76	0·46	0·2	ir 2h.-10h. ; ir_0 21h.
13	992·3	WNW.2	38	47	81	0·10	0·0	r-$r_0$9h.-13h.&21h.-23h.
14	988·6	S.4	38	45	68	0·39	0·1	rh.-5h. & 8h.
15	980·9	WSW.4	38	48	81	0·08	5·4	prhrstl 12h.-15h.
16	991·0	SW.4	37	49	54	0·11	5·5	r17h.-22h.
17	976·6	S.3	37	47	69	0·01	3·0	pr13h.30m.
18	992·7	W.4	36	48	55	—	8·6	
19	990·9	SSE.4	35	49	90	0·08	1·1	r-r_0 8h.-13h.
20	998·2	N.2	42	48	87	0·17	0·0	r-$r_0$3h.-8h.&13h.-19h.
21	1014·4	NW.3	41	46	83	—	0·2	
22	1015·4	W.2	30	48	54	—	5·0	F till 9h.30m.
23	1021·9	W.2	32	50	63	—	2·6	F till 11h.30m.
24	1022·9	SW.2	31	51	73	0·04	1·4	fx early ; r 12h.-14h.
25	1028·8	NNE.2	46	57	45	trace	7·2	r_0 0h.-2h.
26	1021·7	S.2	36	53	84	—	3·7	f 2h.-10h.
27	1024·3	NNE.4	44	53	57	—	3·7	
28	1018·4	E.5	38	49	44	—	9·3	
29	1012·1	NE.3	39	46	55	—	0·4	d_0 9h.
30	1009·9	E.3	36	49	50	—	1·7	
31	1015·5	ENE.4	35	49	56	—	7·2	

General Rainfall for March 1934

England and Wales	110	per cent of the average 1881-1915.
Scotland	97	
Ireland	114	
British Isles	108	

Rainfall: March, 1934: England and Wales.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond	Camden Square	1·96	107	*Leics.*	Thornton Reservoir	2·03	110
Sur	Reigate, Wray Pk. Rd.	2·66	114	,,	Belvoir Castle	1·86	103
Kent	Tenterden, Ashenden	2·96	138	*Rut*	Ridlington	1·67	96
,,	Folkestone, Boro. San.	2·97	...	*Lincs*	Boston, Skirbeck	1·87	120
,,	Eden'bdg., Falconhurst	2·75	111	,,	Cranwell Aerodrome	2·05	146
,,	Sevenoaks, Speldhurst	2·12	...	,,	Skegness, Marine Gdns	1·40	84
Sus	Compton, Compton Ho.	3·22	116	,,	Louth, Westgate	2·32	109
,,	Patching Farm	2·47	115	,,	Brigg, Wrawby St.	1·39	...
,,	Eastbourne, Wil. Sq.	2·93	130	*Notts*	Worksop, Hodsock	2·62	155
,,	Heathfield, Barklye	3·31	132	*Derby*	Derby, L. M. & S. Rly.	1·57	91
Hants	Ventnor, Roy. Nat. Hos.	2·76	135	,,	Buxton, Terr. Slopes	4·12	100
,,	Fordingbridge, Oaklnds	3·42	147	*Ches*	Runcorn, Weston Pt	1·97	97
,,	Ovington Rectory	4·08	157	*Lancs*	Manchester, Whit. Pk.	2·22	98
,,	Sherborne St. John	2·48	111	,,	Stonyhurst College	2·47	67
Herts	Welwyn Garden City	1·99	110	,,	Southport, Hesketh Pk	1·55	70
Bucks	Slough, Upton	2·14	122	,,	Lancaster, Greg Obsy.	2·16	68
,,	H. Wycombe, Flackwell	2·22	110	*Yorks*	Wath-upon-Dearne	1·75	100
Oxf	Oxford, Mag. College	1·62	106	,,	Wakefield, Clarence Pk.	1·72	96
Nor	Pitsford, Sedgebrook	1·55	88	,,	Oughtershaw Hall	5·11	...
,,	Oundle	1·13	...	,,	Wetherby, Ribston H.	2·45	126
Beds	Woburn, Exptl. Farm	1·53	89	,,	Hull, Pearson Park	1·76	97
Cam	Cambridge, Bot. Gdns.	1·09	74	,,	Holme-on-Spalding	1·94	107
Essex	Chelmsford, CountyLab	2·09	121	,,	West Witton, Ivy Ho.	4·80	155
,,	Lexden Hill House	1·89	...	,,	Felixkirk, Mt. St. John	2·47	125
Suff	Haughley House	1·64	...	,,	York, Museum Gdns.	1·95	116
,,	Campsea Ashe	2·20	131	,,	Pickering, Hungate	2·64	133
,,	Lowestoft Sec. School	1·58	98	,,	Scarborough	1·99	111
,,	Bury St.Ed., WestleyH.	2·16	114	,,	Middlesbrough	1·43	91
Norf	Wells, Holkham Hall	1·83	112	,,	Baldersdale, Hury Res.	3·70	119
Wilts	Calne, Castleway	2·23	104	*Durh*	Ushaw College	3·79	172
,,	Porton, W.D.Exp'l.Stn	3·26	165	*Nor*	Newcastle, Town Moor	3·08	146
Dor	Evershot, Melbury Ho.	3·44	115	,,	Bellingham, Highgreen	4·50	153
,,	Weymouth, Westham	2·43	118	,,	Lilburn Tower Gdns	4·35	164
,,	Shaftesbury, Abbey Ho.	2·69	114	*Cumb*	Carlisle, Scaleby Hall	2·28	93
Devon	Plymouth, The Hoe	3·86	133	,,	Borrowdale, Seathwaite	7·75	74
,,	Holne, ChurchPk.Cott.	5·90	110	,,	Borrowdale, Moraine	6·95	83
,,	Teignmouth, Den Gdns.	2·86	110	,,	Keswick, High Hill	2·99	66
,,	Cullompton	2·72	99	*West*	Appleby, Castle Bank	2·32	87
,,	Sidmouth, Sidmount	2·60	107	*Mon*	Abergavenny, Larchf'd	3·27	108
,,	Barnstaple, N.Dev.Ath	2·67	102	*Glam*	Ystalyfera, Wern Ho.	5·46	102
,,	Dartm'r, Cranmere Pool	4·80	...	,,	Cardiff, Ely P. Stn.	2·20	69
,,	Okehampton, Uplands	4·15	100	,,	Treherbert, Tynywaun	7·14	...
Corn	Redruth, Trewirgie	4·91	136	*Carm*	Carmarthen, Priory St.	4·20	111
,,	Penzance, Morrab Gdn.	4·57	143	*Pemb*	Haverfordwest, School	4·10	120
,,	St. Austell, Trevarna	4·49	130	*Card*	Aberystwyth	2·92	...
Soms	Chewton Mendip	3·06	86	*Rad*	BirmW.W.Tyrmynydd	5·87	109
,,	Long Ashton	2·21	87	*Mont*	Lake Vyrnwy	5·58	130
,,	Street, Millfield	2·05	100	*Flint*	Sealand Aerodrome	1·67	93
Glos	Blockley	2·30	..	*Mer*	Dolgelley, Bontddu	5·49	111
,,	Cirencester, Gwynfa	...	...	*Carn*	Llandudno	1·90	93
Here	Ross, Birchlea	2·43	120	,,	Snowdon, L. Llydaw 9	10·49	...
Salop	Church Stretton	2·50	106	*Ang*	Holyhead, Salt Island	1·94	74
,,	Shifnal, Hatton Grange	2·00	109	,,	Lligwy	2·03	...
Staffs	MarketDrayt'n, Old Sp.	1·64	77	*Isle of Man*			
Worc	Ombersley, Holt Lock	1·65	97		Douglas, Boro' Cem.	2·93	98
War	Alcester, Ragley Hall	1·30	76	*Guernsey*			
,,	Birminghm. Edgbaston	2·04	107		St. PeterP't. Grange Rd	4·37	177

Rainfall: March, 1934: Scotland and Ireland.

Co.	Station	In.	Per cent. of Av.	Co.	Station	In.	Per cent. of Av.
Wig .	Pt. William, Monreith	2·70	95	*Suth* .	Melvich	3·87	136
,, .	New Luce School	3·16	89	,, .	Loch More, Achfary	6·20	96
Kirk .	Dalry, Glendarroch	2·85	63	*Caith* .	Wick	2·10	92
,, .	Carsphairn, Shiel	4·14	68	*Ork* .	Deerness	2·78	99
Dumf .	Dumfries, Crichton, R.I	2·28	81	*Shet* .	Lerwick	3·02	96
,, .	Eskdalemuir Obs.	4·46	91	*Cork* .	Caheragh Rectory	6·41	...
Roxb .	Branxholm	3·30	114	,, .	Dunmanway Rectory	7·06	144
Selk .	Ettrick Manse	3·86	76	,, .	Cork, University Coll.	4·49	150
Peeb .	West Linton	3·82	...	,, .	Ballinacurra	4·63	163
Berw .	Marchmont House	4·30	162	,, .	Mallow, Longueville	3·70	128
E. Lot .	North Berwick Res.	3·18	169	*Kerry* .	Valentia Obsy	5·59	123
Midl .	Edinburgh, Roy. Obs.	2·72	138	,, .	Gearhameen	8·70	107
Lan .	Auchtyfardle	...	...	,, .	Darrynane Abbey	6·31	154
Ayr .	Kilmarnock, Kay Pk.	2·09	...	*Wat* .	Waterford, Gortmore	3·21	118
,, .	Girvan, Pinmore	2·85	75	*Tip* .	Nenagh, Cas. Lough	3·54	116
Renf .	Glasgow, Queen's Pk.	2·81	107	,, .	Roscrea, Timoney Park	4·34	...
,, .	Greenock, Prospect H.	3·28	66	,, .	Cashel, Ballinamona	3·16	115
Bute .	Rothesay, Ardencraig.	3·07	...	*Lim* .	Foynes, Coolnanes	3·26	111
,, .	Dougarie Lodge	4·23	...	,, .	Castleconnel Rec.	3·09	...
Arg .	Ardgour House	6·07	...	*Clare* .	Inagh, Mount Callan	5.75	...
,, .	Glen Etive	6·49	82	,, .	Broadford, Hurdlest'n.	3·81	...
,, .	Oban	2·67	...	*Wexf* .	Gorey, Courtown Ho.	3·72	161
,, .	Poltalloch	3·97	104	*Wick* .	Rathnew, Clonmannon	3·20	...
,, .	Inveraray Castle	5·36	85	*Carl* .	Hacketstown Rectory	3·14	112
,, .	Islay, Eallabus	3·39	89	*Leix* .	Blandsfort House	3·05	116
,, .	Mull, Benmore	...	...	,, .	Mountmellick	3.31	...
,, .	Tiree	2·56	76	*Offaly* .	Birr Castle	2·91	121
Kinr .	Loch Leven Sluice	4·37	146	*Dublin*	Dublin, FitzWm. Sq.	2·47	127
Perth .	Loch Dhu	...	...	,, .	Balbriggan, Ardgillan.	2·19	109
,, .	Balquhidder, Stronvar	3·76	...	*Meath* .	Beauparc, St. Cloud	2·57	...
,, .	Crieff, Strathearn Hyd.	3·21	100	,, .	Kells, Headfort	2·38	87
,, .	Blair Castle Gardens	1·70	65	*W. M.* .	Moate, Coolatore	2·93	...
Angus .	Kettins School	3·27	134	,, .	Mullingar, Belvedere	3·43	127
,, .	Pearsie House	3·33	...	*Long* .	Castle Forbes Gdns.	2·83	130
,, .	Montrose, Sunnyside	2·03	98	*Gal* .	Galway, Grammar Sch.	3·69	...
Aber .	Braemar, Bank	2·65	89	,, .	Ballynahinch Castle	6·24	122
,, .	Logie Coldstone Sch.	2·67	103	,, .	Ahascragh, Clonbrock.	3·50	105
,, .	Aberdeen, King's Coll.	1·09	45	*Mayo* .	Blacksod Point	...	...
,, .	Fyvie Castle	2·01	74	,, .	Mallaranny	5·07	...
Moray	Gordon Castle	2·00	86	,, .	Westport House	5·19	133
,, .	Grantown-on-Spey	2·81	106	,, .	Delphi Lodge	9·83	118
Nairn .	Nairn	2·43	130	*Sligo* .	Markree Obsy	4·14	112
Inv's .	Ben Alder Lodge	3·90	...	*Cavan* .	Crossdoney, Kevit Cas.	2·21	...
,, .	Kingussie, The Birches	2·87	...	*Ferm* .	Enniskillen, Portora	2·24	...
,, .	Inverness, Culduthel R.	2·82	...	*Arm* .	Armagh Obsy	1·79	76
,, .	Loch Quoich, Loan	1.60	...	*Down* .	Fofanny Reservoir	4·70	...
,, .	Glenquoich	4·99	51	,, .	Seaforde	1·77	61
,, .	Arisaig, Faire-na-Sguir	2·73	..	,, .	Donaghadee, C. Stn.	1·63	74
,, .	Fort William, Glasdrum	4·69	...	,, .	Banbridge, Milltown	1·81	83
,, .	Skye, Dunvegan	3·51	...	*Antr* .	Belfast, Cavehill Rd.	2·49	...
,, .	Barra, Skallary	3·32	...	,, .	Aldergrove Aerodrome	2·06	82
R & C .	Alness, Ardross Castle	4·88	149	,, .	Ballymena, Harryville	2·70	86
,, .	Ullapool	3·47	83	*Lon* .	Garvagh, Moneydig	2·29	...
,, .	Achnashellach	5·05	70	,, .	Londonderry, Creggan	2·99	93
,, .	Stornoway	3·02	74	*Tyr* .	Omagh, Edenfel	3·26	104
Suth .	Lairg	2·75	89	*Don* .	Malin Head	3·81	..
,, .	Tongue	3·13	93	,, .	Killybegs, Rockmount.	2·83	...

Climatological Table for the British Empire, October, 1933

STATIONS	PRESSURE		TEMPERATURE									PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb	Relative Humidity	Mean Cloud Am'nt	Am'nt	Diff. from Normal	Days	Hours per day	Per-centage of possible
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F	°F.	%	0—10	in.	in.			
London, Kew Obsy.	1012·9	— 1.1	68	32	57·9	45·9	51·9	+ 2·0	46·9	89	6·5	1·44	— 1·26	15	3·5	32
Gibraltar	1015·8	— 1·4	82	48	72·7	60·2	66·5	+ 0·1	60·0	87	6·0	4·94	+ 1·67	10	..	..
Malta	1017·7	+ 1·7	84	61	77·7	66·8	72·3	+ 1·4	66·3	76	4·5	0·29	— 2·58	4	8·4	74
St. Helena	1013·6	— 0·8	69	53	61·3	54·5	57·9	— 0·4	55·5	96	9·8	0·96	..	8	..	..
Freetown, Sierra Leone	1013·5	+ 1·9	88	64	86·3	67·0	76·7	— 3·4	75·3	82	4·5	7·78	— 4·84	23	..	..
Lagos, Nigeria	1012·1	+ 1·1	90	70	85·1	74·4	79·7	0·0	75·5	86	8·7	6·01	— 1·76	15	6·0	50
Kaduna, Nigeria	1011·9	— 1·4	96	59	90·4	63·7	77·1	+ 0·8	69·4	74	3·9	0·30	— 2·45	1	8·8	74
Zomba, Nyasaland	1008·8	— 2·1	93	53	86·4	63·1	74·7	+ 0·6	63·2	48	2·2	0·00	— 1·52	0	..	..
Salisbury, Rhodesia	1010·7	— 0·9	91	46	84·8	57·0	70·9	+ 0·2	57·0	34	1·5	0·35	— 0·78	4	10·0	80
Cape Town	1016·8	— 0·6	88	41	72·0	54·0	63·0	+ 1·8	56·3	74	4·2	1·35	— 0·30	7	..	..
Johannesburg	1011·6	— 0·2	87	36	78·8	52·0	65·4	+ 2·6	51·9	39	1·8	0·79	— 1·77	8	9·7	76
Mauritius	1018·3	+ 0·1	84	62	79·3	64·6	72·0	— 0·7	66·4	60	5·5	0·73	— 0·65	10	9·1	73
Calcutta, Alipore Obsy.	1009·1	— 0·3	93	67	88·0	74·8	81·4	+ 2·1	75·9	87	3·8	9·71	+ 4·81	9	..	..
Bombay	1008·2	— 1·6	94	72	90·0	75·9	82·9	+ 0·5	75·4	79	3·8	3·04	+ 1·37	7	..	..
Madras	1007·6	— 1·3	94	72	86·8	75·5	81·1	— 1·2	75·9	86	8·0	9·87	— 1·28	11	..	..
Colombo, Ceylon	1010·1	+ 0·1	85	72	83·1	75·1	79·1	— 1·4	76·0	80	7·2	8·43	— 4·93	25	5·5	46
Singapore	1009·2	— 0·5	92	70	86·5	74·0	80·3	— 0·8	76·8	81	6·6	7·63	— 0·44	18	5·1	42
Hongkong	1013·9	+ 0·2	90	65	82·3	73·1	77·7	+ 0·8	69·4	66	6·3	3·75	— 1·19	13	6·2	53
Sandakan	1008·7	..	91	72	87·6	74·8	81·2	— 0·2	77·1	82	7·9	14·96	+ 4·63	18	..	..
Sydney, N.S.W.	1015·6	+ 0·8	93	49	71·7	56·6	64·1	+ 0·5	60·0	66	5·6	4·06	+ 1·21	10	7·8	60
Melbourne	1015·2	+ 0·4	96	39	71·2	48·9	60·1	+ 2·4	53·9	56	5·6	1·56	— 1·07	12	5·9	46
Adelaide	1016·2	+ 0·2	99	39	73·8	51·0	62·4	+ 0·4	54·5	45	6·1	0·64	— 1·09	11	7·3	57
Perth, W. Australia	1016·4	— 0·4	83	42	69·2	53·0	61·1	+ 0·3	56·4	64	5·4	5·09	+ 2·87	14	7·3	57
Coolgardie	1014·2	— 0·9	102	37	78·5	49·0	63·7	0·0	54·6	38	2·2	0·55	— 0·11	5	..	..
Brisbane	1016·5	+ 0·3	89	55	78·6	62·2	70·4	+ 0·6	63·9	63	5·4	3·82	+ 1·29	13	8·4	66
Hobart, Tasmania	1010·1	— 2·2	82	38	64·6	47·8	56·2	+ 2·1	49·7	57	7·1	4·30	+ 2·04	14	6·2	47
Wellington, N.Z.	1015·8	+ 2·7	64	37	58·5	46·5	52·5	— 1·9	49·8	73	7·2	2·17	— 1·91	9	7·5	57
Suva, Fiji	1013·8	+ 0·6	87	64	81·6	71·1	76·3	+ 0·5	71·9	77	7·9	14·52	+ 6·23	23	4·6	37
Apia, Samoa	1011·4	— 0·1	87	70	84·6	73·5	79·0	+ 0·6	76·0	77	6·6	9·71	+ 3·33	21	7·0	56
Kingston, Jamaica	1009·3	— 2·2	90	70	85·2	72·7	78·9	— 1·6	73·0	90	6·2	17·98	+ 10·52	18	5·2	44
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1018·6	+ 1·1	69	22	55·3	40·3	47·8	— 0·8	42·8	81	5·1	2·26	— 0·31	15	5·0	45
Winnipeg	1016·6	+ 1·7	73	14	45·3	27·3	36·3	— 4·4	29·4	84	7·1	0·01	— 1·36	1	4·0	37
St. John, N.B.	1017·3	+ 1·5	66	27	54·7	41·2	47·9	+ 2·6	43·9	80	5·8	7·90	+ 3·36	19	4·3	39
Victoria, B.C.	1016·1	— 1·0	72	40	57·0	46·0	51·5	+ 1·2	49·0	86	6·0	4·98	+ 2·41	16	5·2	48

*For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

Victoria, B.C. ......| 1910 |

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.